

EUSTIGMAEUS JOHNSTONI, NEW SPECIES (ACARI:
STIGMAEIDAE), PARASITIC ON PHLEBOTOMINE
SANDFLIES (DIPTERA: PSYCHODIDAE)

Zhang, Z.-Q., & U. Gerson, 1995. *Eustigmaeus johnstoni*, new species (Acari: Stigmaeidae), parasitic on phlebotomine sandflies (Diptera: Psychodidae). – Tijdschrift voor Entomologie 138: 297–301, fig. 1–6. [ISSN 0040-7469]. Published 15 November 1995.

Eustigmaeus johnstoni sp. n. (Acari: Stigmaeidae) is described from several species of phlebotomine sandflies (Diptera: Psychodidae) in tropical areas. Adult females of this species were found on *Phlebotomus papatasi* (Scopoli), *Sergentomyia magna* (Sinton) and *Sergentomyia dreyfussi* (Parrot) in Yemen, on *P. papatasi*, *Sergentomyia africana* Newstead and an undetermined species of *Sergentomyia* in Saudi Arabia, on *P. papatasi* in Cyprus, Israel, and Pakistan, and on *Phlebotomus longicuspis* Nitzulescu in Tunisia. Both males and females of sandfly hosts were parasitized. The new species is eyeless and is separated from other eyeless species of *Eustigmaeus* in an artificial key.

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Mites of the genus *Eustigmaeus* Berlese, 1910 (= *Ledermuelleria* Oudemans, 1923) (Prostigmata: Stigmaeidae) comprise a group of globose, red acarines whose bodies are covered by ornamental armour. In females this dorsal armour is separated into propodosomal and hysterosomal plates, the latter being often subdivided in the males. Females carry 13 variously-shaped dorsal setae, of which three are often ventrally displaced: the humerals (c_1) laterally and the posterior-most h_1 and h_2 caudally. Most species have one pair of eyes, located between propodosomal setae *ve* and *sci*. The eyeless species include *E. lirella* (Summers & Price), *E. coronaria* (Kuznetsov), *E. parasitica* (Chaudhri), *E. gamma* (Chaudhri), *E. gorgasi* (Chaudhri) and the new species described in this paper.

The species *E. lirella* and *E. coronaria* were collected from 'soil and screenings from the nest of woodrat' (Summers & Price 1961) and from the hollow of an ash tree (Kuznetsov 1977), respectively. The species *E. parasitica*, *E. gamma*, and *E. gorgasi* were found associated with phlebotomine sandflies (Diptera: Psychodidae) and were presumed ectoparasitic (Chaudhri 1965). This association was challenged by Gerson (1972) who argued that as some species of *Eustigmaeus* feed on mosses (bryophytes), a habitat wherein many sandflies rest, the mites' occurrence on the flies might be only a fortuitous phoretic association.

This argument is no longer tenable in view of the

many additional sandfly-parasitizing specimens of *Eustigmaeus* which have since been collected (Abonnenc 1970, Lewis & Macfarlane 1982, Martinez-Ortega et al. 1983). The evidence presented in there patently shows that these *Eustigmaeus* mites actually feed on the flies, leaving feeding wounds or scars on hosts' bodies. Abonnenc (1970) has described a new sandfly-associated species, *Eustigmaeus dyemkoumai*, which does have eyes, and herein we describe a new species which is eyeless. Setal terminology follows Kethley (1990). All measurements are of the holotype female and are in micrometers.

TAXONOMY

Eustigmaeus johnstoni sp. n. (Figs. 1–6)

Type material. – Holotype female (ZQZ941012-1a) and two paratype females (ZQZ941012-1, b & c), YEMEN: Zabid, ex. female *Sergentomyia magna* (Sinton), 10.xii.1970, B. Deringhi. Paratype female (ZQZ941012-2), YEMEN: Zabid, ex. male *Sergentomyia dreyfussi* (Parrot), 2.xii.1970, B. Deringhi. Paratype female (ZQZ941012-6), SAUDI ARABIA, ex. male of *Sergentomyia* sp., 2.iii.1979, W. Bütiker. Holotypes and paratypes are deposited in the Natural History Museum, London (BMNH). One paratype is in the collection of Uri Gerson, Department of Entomology, The Hebrew University of Jerusalem.

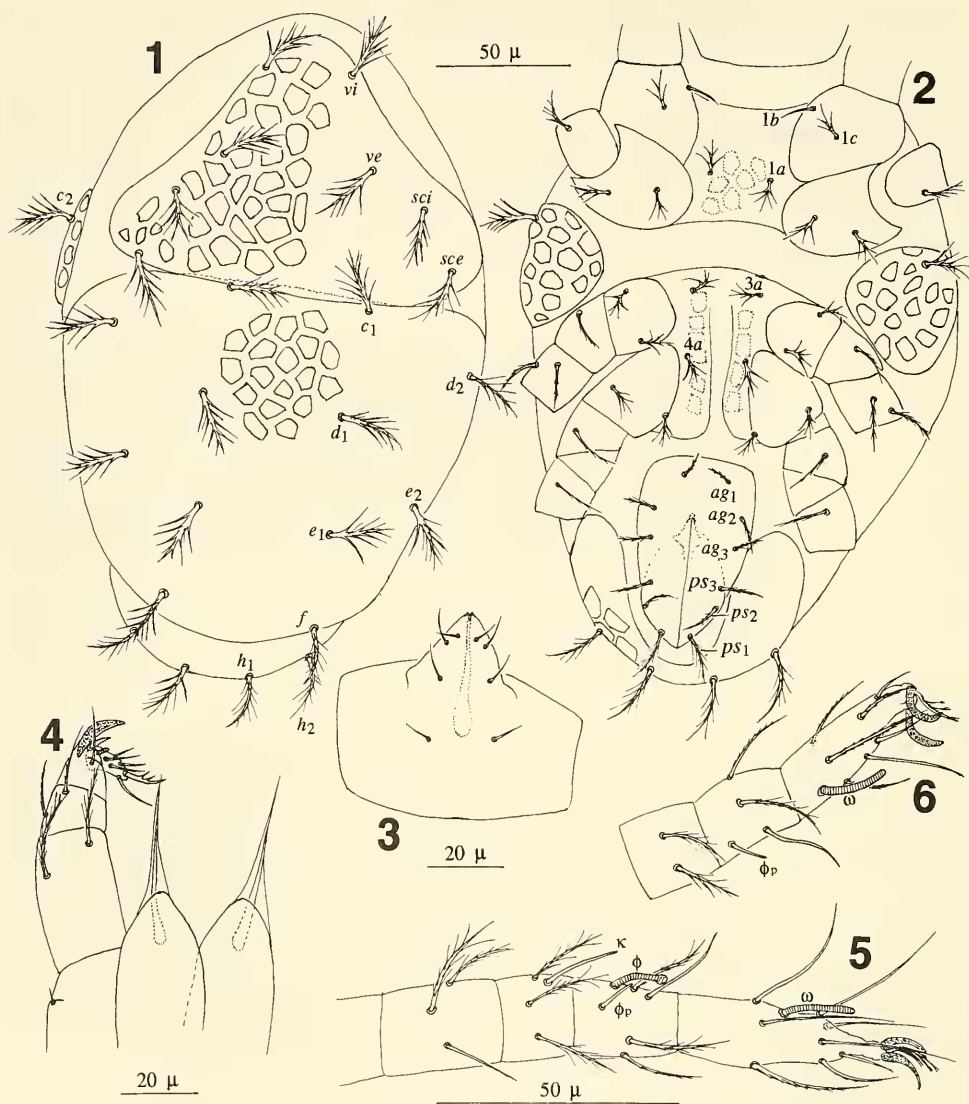


Fig. 1-6. *Eustigmaeus johnstoni* sp. n. (Holotype female). – 1, Idiosoma, dorsal view; 2, Idiosoma, ventral view; 3, Subcapitulum; 4, Palp and chelicera; 5, Leg I; 6, Leg II.

Other material. – Other examined specimens (all females) were excluded from the type series because of poor slide mount. SOUTH YEMEN: Hadramawt, ex. female *Phlebotomus papatasi* (Scopoli), D. M. Minter (ZQZ941012-4). CYPRUS: Larnaca, ex. male *P. papatasi*, 21.ix.1980, M. Jennings (ZQZ941012-3). SAUDI ARABIA, ex. *P. papatasi*, W. Bürtiker 10.x.1977, 1978, 28.iii.1978, 2.vii.1976, 16.x.1978, 10.iii.1979 (ZQZ941012-5, 8, 9, 10, 11, 12), ex. female *Sergentomyia africana* Newstead, 10.iii.1979 (ZQZ941012-7). PAKISTAN: Janodola, ex. female *P. papatasi*, 18.viii.1923

(ZQZ941012-14); Lahore, ex. *P. papatasi*, 29.x.1923 (ZQZ941012-15); ex. *P. papatasi*, 4.xi.1923 (ZQZ941012-16). TUNISIA: Tunis, ex. *P. longicuspis* Nitzulescu, 19-26.vi.1969, P.D. Massa (ZQZ941012-17; c1e A4003). Additional female specimens from *P. papatasi* (collected by Y. Schlein in the summer of 1984 in Gilgal, Jordan Valley, Israel) were examined by U. Gerson.

Diagnosis. – Eyeless species of medium size. Dorsal setae subequal, each 15-35 long, with 10-15 long

Table 1. Measurements (in μ) of dorsal setae and setal distances in *Eustigmaeus johntoni* females from different areas.

	Yemen	Saudi Arabia	Cyprus	Tunis	Pakistan	mean \pm se	n
<i>vi</i>	22- 32	19- 23	24	21	21	22.3 \pm 1.0	14
<i>ve</i>	23- 28	19- 21	23	22	21	21.9 \pm 0.8	15
<i>sci</i>	18- 23	15- 20	21	21	19	19.2 \pm 0.7	13
<i>sce</i>	22- 28	19- 23	21	21	21-23	21.8 \pm 0.9	14
<i>c₁</i>	22- 26	19- 23	21	23	21	21.5 \pm 0.5	15
<i>c₂</i>	22- 28	19- 23	22	23	22-23	22.6 \pm 0.6	14
<i>d₁</i>	19- 28	19- 21	21	23	21-22	21.3 \pm 0.7	15
<i>d₂</i>	19- 26	17- 21	21	21	20-21	20.6 \pm 0.6	14
<i>e₁</i>	22- 28	21- 23	23	21	20-21	22.4 \pm 0.5	15
<i>e₂</i>	20- 23	19- 23	23	19	20-21	20.8 \pm 0.5	14
<i>f</i>	24- 35	21- 25	28	24	23-24	25.5 \pm 1.1	15
<i>h₁</i>	22- 32	20- 26	24	21	24	24.4 \pm 1.0	13
<i>h₂</i>	23- 24	19- 23	21	19	21	21.5 \pm 0.5	13
<i>vi-vi</i>	32- 34	23- 32	30	28	26-27	28.8 \pm 1.0	13
<i>ve-ve</i>	54- 56	41- 49	47	47	42-50	47.8 \pm 1.4	13
<i>sci-sci</i>	91- 95	80- 86	86	86	78-81	85.0 \pm 1.5	13
<i>sce-sce</i>	112-120	100-114	109	103	105	107.0 \pm 1.8	12
<i>c₁-c₁</i>	51- 60	41- 54	50	50	52-53	50.5 \pm 1.3	13
<i>d₁-d₁</i>	40- 56	43- 52	54	53	47-52	49.8 \pm 1.4	13
<i>d₂-d₂</i>	133-140	106-128	126	116	116	122.0 \pm 3.0	12
<i>e₁-e₁</i>	44- 49	34- 45	43	42	40	42.1 \pm 1.1	12
<i>e₂-e₂</i>	110-116	84- 111	100	92	90	99.5 \pm 3.2	11
<i>f-f</i>	56- 59	48- 60	54	50	52-57	54.0 \pm 1.0	12
<i>h₁-h₁</i>	24- 26	19- 25	23	22	17-21	22.0 \pm 0.8	12
<i>h₂-h₂</i>	56- 71	49- 63	58	54	54	58.2 \pm 1.8	11

branches. Intercoxal setae 1*a*, 3*a*, and 4*a* subequal, each 9-11 long and with 4-6 long branches. Coxal setae similar to intercoxal setae except for the nude 1*b*. Dorsal solenidion (ϕ) on tibia I with a characteristic bulbous tip.

Description

Female. – Idiosoma 240 long, 160 wide. Dorsal plates covered with prominent polygonal cells (Fig. 1). Propodosoma with ten polygonal cells arranged transversely between setae *sce* and eight or nine cells longitudinally. No eyes present between setae *ve* and *sci* on propodosoma. Hysterosoma with 12-13 transverse cells between setae *d₂* and 12-14 cells longitudinally. Humeral plates large, with 12-14 polygonal cells and setae *c₁*. Dorsal idiosoma with 13 pairs of setae, each with 10-15 branches emerging along entire shaft and not clustered together. Measurements of setae: *vi* 22; *ve* 23; *sci* 18; *sce* 22; *c₁* 22; *c₂* 22; *d₁* 22; *d₂* 19; *e₁* 22; *e₂* 20; *f* 24; *h₁* 22; *h₂* 24. Distances between alveoli of setae: *vi-vi* 32; *ve-ve* 55; *sci-sci* 91; *sce-sce* 112; *c₁-c₁* 51; *d₁-d₁* 40; *d₂-d₂* 133; *e₁-e₁* 49; *e₂-e₂* 110; *f-f* 56; *h₁-h₁* 24; *h₂-h₂* 65. Variations of setal measurements for specimens from different areas are summarized in Table 1.

On ventral side of idiosoma, intercoxal plate with weak outlines of polygonal cells, continuous across mid-ventral line, separated beyond coxae II by transverse striae (Fig. 2). Intercoxal plate between coxae III and IV with similar weak outlines of polygonal cells,

but divided by longitudinal striae between coxae III. Intercoxal setae 1*a*, 3*a*, and 4*a* subequal, each 9-11 long and with 4-6 branches. Coxal setae similar to intercoxal setae in structure except the nude 1*b*. Three pairs of aggenital setae present; *ag₁* (9) slightly shorter than *ag₂* and *ag₃* (both 10-11). Anal valve with three pairs of *ps* setae; *ps₁* longest (17), with longer barbs than *ps₂* and *ps₃*.

Gnathosoma. Subcapitulum with two pairs of adoral setae distally and two pairs of subcapitular setae proximally (Fig. 3). These setae each very weakly branched. Palp 64 long from base of femur to tip of tibia (Fig. 4). Palpfemur with three setae, two dorsal, strongly barbed, and the third ventral, weakly branched. Palp genu and palptibia each with two setae. Palptibial claw 13 long, almost reaching the end of palptarsus. Accessory claw 5 long. Palptarsus cylindrical, with seven setae, including subbasal solenidion and apical trifid sensillum (Fig. 4). Cheliceral base 49 long, 23 wide. Styler 47 long.

Legs. Each tarsus terminating in a pair of strong claws and an empodium bearing three paired branches. Length of legs I, II, III and IV (from base of trochanter to tip of claw) 127, 106, 106, and 121, respectively. Number of ordinary setae and sensillae (in parentheses) on legs I-IV: coxae 2-2-2-2; trochantera 1-1-1-1; femora 6-5-3-2; genua 3(1)-3(1)-1-1; tibia 5(2)-5(1)-5(1)-5(1); tarsi 12(1)-8(1)-7(1)-7. Dorsal solenidion ϕ on leg I with a characteristic bulbous tip

and p on leg I about half as long as normal setae on tibia I (Fig. 5). Numerous dorsal setae on podomeres strongly branched (Figs. 5, 6). Microseta κ on leg I nearly as long as other setae on genu I. Microseta κ on leg II normal, visible only in well preserved and positioned specimens.

Males and immatures not seen.

Etymology. — This species is named to commemorate our esteemed late colleague, the prominent acarologist Prof. Donald E. Johnston of the Ohio State University, Columbus, Ohio, USA.

Remarks. — This new species is a very widespread species, at least present in Yemen, Saudi Arabia, Israel, Cyprus, Tunis, and Pakistan. Within species variation in the lengths of and distances between dorsal seta are evident in specimens from different countries. This new species shows a striking resemblance to *E. dyemkougmai*, which is parasitic on *Phlebotomus duboscqi* Neveu-Lemaire in Upper-Volta and Mali (Abonnenc 1970). Both species have characteristic dorsal setae with long branches and their intercoxal setae (1a, 3a and 4a) carry similar structures (Figs. 1-2). *E. dyemkougmai* was only briefly described, but an examination of a type specimen revealed that *E. johnstoni* differs from *E. dyemkougmai* by its relatively larger size, by the absence of eyes, by the bulbous tip of ϕ on leg I, and by having more branches on the dorsal setae. Like *E. johnstoni*, five other species of *Eustigmaeus* have also lost their eyes. They can be separated by using the following key, which serves to emphasize the lack of other features common to these mites. Species found in association with phlebotomine sandflies are denoted by an asterisk.

Key to eyeless *Eustigmaeus*

- 1 Dorsal hysterosomal setae c_1 and d_1 short, not reaching the bases (alveoli) of any neighbouring setae 2
- Dorsal hysterosomal setae c_1 and d_1 long, overreaching the bases (alveoli) of at least two neighbouring setae 4
- 2 Distance between alveoli of dorsal setae pairs, c_1 - c_1 , d_1 - d_1 , and e_1 - e_1 , subequal 3
- Distance c_1 - c_1 and d_1 - d_1 subequal, both much less than e_1 - e_1 (setae e_1 laterally displaced) ... *gamma**
- 3 Dorsal setae flat, with short barbs on distal 3/4; all intercoxal setae (1a, 3a, and 4a) weakly barbed *lirella*
- Dorsal setae thin, with long branches throughout; intercoxal setae (1a, 3a, and 4a) with long branches *johnstoni* sp. n.*
- 4 Femur IV with two setae 5
- Femur IV with three setae *parasitica**
- 5 Dorsal setae c_1 , d_1 , and e_1 of uniform width, not

flattened near the base; setae p_1 to p_3 subequal *gorgasi**

— Dorsal setae c_1 , d_1 , and e_1 flattened near their bases; length of seta p_3 1.5 times that of p_1 or p_2 *coronaria*

The fact that four species of *Eustigmaeus* were found to parasitize phlebotomine sandflies indicates that this is not a fortuitous occurrence. This statement is supported by the presence of two additional undescribed species, one from *Phlebotomus cruciatus* Coquillett in Honduras and the other from *Phlebotomus longipes* Parrot & Martin in Ethiopia, in the collections of the Natural History Museum (they were not described in this paper because only a single specimen each was available). Although phlebotomine sandflies are also parasitized by other mites (Lewis & Macfarlane 1982), no species of *Eustigmaeus* have ever been found on other animal hosts. The nature of *Eustigmaeus*-sandfly association, however, remains obscure. No males or immatures of *Eustigmaeus* have been collected on phlebotomine sandflies, nor have any been found in alcohol-preserved museum specimens. This suggests that the phlebotomine-associated *Eustigmaeus* species develop and mate elsewhere, probably in the habitat where sandflies breed and rest; parasitism may thus be only one phase in the life history of these mites.

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REFERENCES

- Abonnenc, E., 1970. Notes sur les Acariens parasites des Phlébotomes. — Cahiers L'office de la Recherche Scientifique et Technique Outer-Mer. Série Entomologie médicale et Parasitologie 8: 89-94.
- Chaudhri, W.M., 1965. New mites of the genus *Ledermuelleria*. — Acarologia 7: 467-486.
- Gerson, U., 1972. Mites of the genus *Ledermuelleria* (Prostigmata: Stigmaeidae) associated with mosses in Canada. Acarologia 13: 319-343.
- Kethley, J., 1990. Acarina: Prostigmata (Actiniedida). — In: D. L. Dindal (ed), Soil Biology Guide, John Wiley, New York. pp. 667-756.
- Kuznetsov, N. N., 1977. New species of the family Stig-

- maeidae from Crimea. – Zoologicheskii Zhurnal 56: 635-638 [in Russian].
- Lewis, D. J., & D. Macfarlane, 1982. The mites of Phlebotomine sandflies (Diptera: Psychodidae). – In: E. U. Canning (ed), Society of Protozoologists Special Publication No. 1, Allen Press, Kansas. pp. 177-183.
- Martinez-Ortega, E., C. E. Conesa-Gallego, D. Macfarlane, & R. D. Ward, 1983. Ectoparasitic mites on phlebotomine sandflies (Diptera: Psychodidae) from Spain. – Annals of Tropical Medicine and Parasitology 77: 545-546.
- Summers, F. M. & D. W. Price, 1961. New and redescribed species of *Ledermuelleria* from North America (Acarina: Stigmaeidae). – Hilgardia 31: 369-387.
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